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AN ENTIRE NEW WORK,

AND METHOD OF PROCEEDING TO DISCOVER

The Variation of the EARTH's DIAMETERS,

With Evidences laid down, amounting to a Demonſtration, that its true Ratio is not leſs variable than as 45 is to 46, and ſhorteſt in its Pole's Axis 17¼ Miles;

And that no Degree of Gravity given by the Quadrant on its Superficies is attached to the Curveture found there, but are ſuch mean Proportionals between the Curvature and the Centre of the Spheroid;

That each Meridional Degree at the Surface will form equal Areas to the common Centre of Gravity, the Earth's Centre.

Offered to the Conſideration of thoſe who are Judges of this important Problem.

WITH A VARIETY OF

NEW TABLES,

SUITED TO THE SUBJECT.

By THOMAS WILLIAMS, INVENTOR.

> There's ſcarce one bold, one noble Mind,
> Dares tread the fatal Frror back;
> But Hand in Hand ourſelves we bind,
> And drag the Age along.
>
> J. WATTS, D.D.

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Method of proceeding to diſcover the Variation of the Earth's Diameter.

IT ſo happened a few Years ago, as I was caſting my Eye on a Book of the Publications of the Society for encouraging of Arts and Commerce, I found therein a Reward offered for an effectual Method for Standard for Weight and Meaſure, a Deficiency being found in the Clock Pendulum to anſwer that Purpoſe to their Satisfaction. I recollected myſelf:—I really judged that if the Quantity of this fifty-ſecond Degree of the Meridian, on which London ſtands, could be attained within one Second, it might be ſettled from that. I conſulted various Authors, none of which could give me that Satisfaction I wiſhed; for I found that, about two hundred Years ago, they thought a Degree contained but about fifty-ſeven Engliſh Statute Miles: But ſince that, Mr. Oughtred aſſerted it to be more than ſixty-ſix; and Mr. Norwood aſſerts it to be nearly on ſixty-nine Miles and one half, as he found it by actual Meaſurement between London and York. I alſo conſulted other more modern Authors; the Arch meaſured by the Company in Lapland, and alſo at Peru on the Equator; alſo thoſe meaſured in France; by which I collected Standards to frame my Table of Meredional Degrees from. By nicely obſerving the Difference between the meaſured Degrees in various Latitudes, I found that the Increaſe of the Meridional Degrees muſt of Neceſſity be by ſome progreſſive, increaſive Order. I began to proceed to find a Method to diſcover that Order. After a few Trials, I dropt on this here laid down, which which may be made demonſtrable to be the real Curve of the Earth, or ſo near to it, that the inconſiderable Variation from it never will affect or injure any Concluſions that may be drawn from it. Other Tables of the like Kind, and all variable the one from the other, I have laid down; but as none would approach nearer to agree with the actual meaſured Meridians, I have adopted this as the moſt accurate.——An extenſive Demonſtration may be laid down, that the Pole Meridional Degree is truly attained by this Table, and is to that at the Equator nearly as forty-ſix is to forty-five, whereas it has formerly been thought to be but nearly as ſeventy-ſeven is to ſeventy-ſix. Here is then a moſt important Point gained in the firſt Place, as it muſt be allowed that the Diameters will vary proportionably to the firſt and laſt Degree, be they found what they will. It will be found by this Table, that whatever any Degree of the Meridian does exceed that found at the Equator, is the Sum of the Arithmetical Progreſſion of a certain Increment, which is the firſt and ſmalleſt found in the Table of Increments, which is nearly on twenty-three Inches and one Quarter Engliſh Meaſure. Thus the Sum of the Arithmetical Progreſſion up to fifty-two, amounts to One Thouſand Three Hundred Seventy-eight, which multiplied

Method of proceeding to diſcover the Variation of the Earth's Diameter.

IT ſo happened a few Years ago, as I was caſting my Eye on a Book of the Publications of the Society for encouraging of Arts and Commerce, I found therein a Reward offered for an effectual Method for Standard for Weight and Meaſure, a Deficiency being found in the Clock Pendulum to anſwer that Purpoſe to their Satisfaction. I recollected myſelf:—I really judged that if the Quantity of this fifty-ſecond Degree of the Meridian, on which London ſtands, could be attained within one Second, it might be ſettled from that. I conſulted various Authors, none of which could give me that Satisfaction I wiſhed; for I found that, about two hundred Years ago, they thought a Degree contained but about fifty-ſeven Engliſh Statute Miles: But ſince that, Mr. Oughtred aſſerted it to be more than ſixty-ſix; and Mr. Norwood aſſerts it to be nearly on ſixty-nine Miles and one half, as he found it by actual Meaſurement between London and York. I alſo conſulted other more modern Authors; the Arch meaſured by the Company in Lapland, and alſo at Peru on the Equator; alſo thoſe meaſured in France; by which I collected Standards to frame my Table of Meredional Degrees from. By nicely obſerving the Difference between the meaſured Degrees in various Latitudes, I found that the Increaſe of the Meridional Degrees muſt of Neceſſity be by ſome progreſſive, increaſive Order. I began to proceed to find a Method to diſcover that Order. After a few Trials, I dropt on this here laid down, which which may be made demonſtrable to be the real Curve of the Earth, or ſo near to it, that the inconſiderable Variation from it never will affect or injure any Concluſions that may be drawn from it. Other Tables of the like Kind, and all variable the one from the other, I have laid down; but as none would approach nearer to agree with the actual meaſured Meridians, I have adopted this as the moſt accurate.——An extenſive Demonſtration may be laid down, that the Pole Meridional Degree is truly attained by this Table, and is to that at the Equator nearly as forty-ſix is to forty-five, whereas it has formerly been thought to be but nearly as ſeventy-ſeven is to ſeventy-ſix. Here is then a moſt important Point gained in the firſt Place, as it muſt be allowed that the Diameters will vary proportionably to the firſt and laſt Degree, be they found what they will. It will be found by this Table, that whatever any Degree of the Meridian does exceed that found at the Equator, is the Sum of the Arithmetical Progreſſion of a certain Increment, which is the firſt and ſmalleſt found in the Table of Increments, which is nearly on twenty-three Inches and one Quarter Engliſh Meaſure. Thus the Sum of the Arithmetical Progreſſion up to fifty-two, amounts to One Thouſand Three Hundred Seventy-eight, which multiplied by the original Increment appertaining to the Curve, amounts to Two Thouſand Six Hundred and Seventy-eight Feet and Parts, which is what the Fifty-ſecond Meridional Degree exceeds that found at the Equator; and ſo by any other Meridional Degree, its Quantity is found, but what each Meridional Degree exceeds that which was next before it, is the Number expreſſed in the Table of Increments here laid down. The Meridional Degree, meaſured at the Equator, was found to be Fifty-ſix Thouſand Seven Hundred and Fifty-three French Toiſes; the Standard I reduce by is 76-71 Inches Engliſh Meaſure: if it can be proved that the Toiſe is ſome ſmall Matter more, as ſome affirm, each Degree in the Table will be ſome ſmall Matter more alſo; but the Analogy will remain ſtill the ſame. The Quantities, both in the Table of the Increments and the Table of the Meridional Degrees, are expreſſed in Engliſh Feet and Decimal Parts. The ſtricteſt Regard ſhould be had to the true Standard of the Toiſe that the Degrees are meaſured by, becauſe an Error of the one-tenth Part of an Inch on that alters near ten Miles in the whole Diameter of the Earth. By the Tables agreeing with the Meaſurement in Lapland and Peru, and alſo in Mean between thoſe two meaſured in Italy (at Rome and Turin); granting, I ſay, thoſe three Points to be right, which nothing can agree nearer to the actual Meaſurement, the Numbers in the Table can be demonſtrated to be anſwerable to the Curve of the Earth, and to gain the Quantities of all the Meridional Degrees perfect quite to the Pole, though in that inhoſpitable Region unmeaſureable by any other Method. That the Degrees towards the Pole are attained truly, might be known on this Reaſon: Subtract every tenth Degree in the Table, the one from the other, and it will be found to be nearly in this Order; as 1, 3, 5, 7, 9, 11, 13, 15, 17; that is to ſay, if the tenth Degree from the Equator exceeds that at the Equator One Hundred Feet, the Twentieth will exceed the Tenth three hundred Feet, the Thirtieth will exceed the Twentieth five hundred Feet, the Fortieth will exceed the Thirtieth ſeven hundred Feet, the Fiftieth will exceed the Fortieth nine hundred Feet, the Sixtieth will exceed the Fiftieth eleven hundred Feet, the Seventieth will exceed the Sixtieth thirteen hundred Feet; and all this Part of the Table agrees with the actual Meaſurements as near as ever can be expected in the mean Latitudes, and exactly at the Polar Circle and the Equator; from which Reaſon there is every Principle of Self-Evidence to conclude that the Eightieth Degree exceeds the Seventieth, on the ſame Reaſon, viz. fifteen hundred Feet; and alſo the Ninetieth exceeds the Eightieth ſeventeen hundred Feet; and of Conſequence the whole Curve is attained truly, as may be made demonſtrable on other Kind of Evidence, to the full Satisfaction of any juſt Enquirer. Thus the Inaccuracy of various meaſured Meridional Degrees on the Earth's Surface is diſcovered; that at the Cape of Good Hope was meaſured at too much, that at Pennſylvania at too little, that at Turin too much, that at Rome too little, that at Hungary conſiderably too little; that meaſured by Mr. Norwood, here in England, conſiderably too much; and thoſe meaſured at France, Vienna, and Holland, pretty near the Tabular Numbers, but a ſmall Matter leſs, about two hundred Feet each. Yet it may be demonſtrated from thoſe meaſured in the mean Latitudes, that

that the Arch, meaſured at the Polar Circle, was not taken at too much, nor that meaſured at the Equator taken at too little; and of conſequence the two extreme Meridional Degrees on the Globe are not leſs variable than as 45 is to 46. From this Principle was the Invention of the Table of Meridional Degrees firſt laid down, to diſcover the Quantity of the Meridional Degrees, to collect from ſome one or other of them a true Standard for Weight and Meaſure, as might infallibly be done by making the millioneth Part of this fifty-ſecond Meridional Degree a Geographical Foot, and, cub'd and filled with Ocean Water, a Geographical Pound. A Method of Proceeding, with large Explanations, I gave in to the before-mentioned Society at the Adelphi; neither had I at the Time of Invention the leaſt Thought of applying it to any farther Uſe reſpecting this Globe; but, on farther Reflection, I found the Diameters of the Globe could be concluded from it much nearer than before known to be, and much more variable than has been generally underſtood to be, as it can be infallibly proved from Sir Iſaac Newton's Principles, as Gravity reſpects Matter, that the Pole's Axis is to the Diameter at the Equator as 45 is to 46, and, of Conſequence, varies in its Diameters 174 Miles, as farther on in this Work a manifeſt Reaſon will be given.

Thus by obtaining the Quantities of all the Degrees in the Curve, in this numerical Way, the Quantity of the Pole Meridional Degree is actually found as a Ground-Work for to proceed to the next moſt important Point, which is this:— The Proportion as the two Diameters of the Spheroid will really be to the two Degrees given by the Quadrant at the Equator and at the Pole. To come to a certain Knowledge of this Matter, then, it is abſolutely neceſſary that a clear Diſcrimination be made with Reſpect to the Proportion, as the Ratio of Curvature found in the extreme Parts of a Spheroid will be to the Diameters of the ſame Spheroids; and here, for Brevity's Sake, I will ſuppoſe the Cubes of the Diameters of Spheroids to be the Ratio of Curvature, as it is not ſo far from it but that it might be accommodated to illuſtrate it for the preſent Purpoſe. Suppoſe, then, the Diameters of a Spheroid to be One Hundred by One Hundred and One, what is the Proportion of the Curvature in the two Extremes of the ſame Spheroid? The Cubes of the two Diameters, reduced to their loweſt Terms, ſtand at 33 by 34, a much more variable Ratio, and is to the Ratio of the Diameters nearly as 3 to 9, or as 1 to 3. So again, let the Diameters of the Spheriod given be as One Thouſand by One Thouſand and One, the Curvature, ſuppoſing it to be the Cubes of the Diameters as before, will ſtand at 333 by 334, and ſtill is found as variable from the Ratio of the Diameters given, as the firſt-named Proportion 100 by 101, viz. nearly as 3 to 9, or as 1 to 3. Again, ſuppoſe the Diameters of the Spheroid given to be in the Proportion as One Million by One Million and One, proceed as before, and the Ratio of Curvature is found to be 333,333 by 333,334, and full as variable from the Proportion of the two Diameters given, as before, viz. as 3 to 9, or as 1 to 3, and ſo continually on the ſame, even though the Variation in the whole Magnitude of the Earth was but one Mile, one Foot, or even the Thickneſs of a Leaf of Gold, the Ratio of Curvature will ever be as variable from the Ratio of the two Diameters

as

as though the Poles fell in five hundred Miles each. Now, foraſmuch as the two extreme Degrees given by the Quadrant on the perfect Sphere will of Neceſſity be equal, becauſe the Diameters are equal, it is abſurd and an abſolute Impoſſibility that the Quantity of a Degree, given by the Quadrant in the two Extremes, on the Spheroid, can be proportioned to the Curvature found there. They will be equal when it's a Sphere, and the Depreſſion of the Pole one Foot in the whole Magnitude of the Earth; that ſmall Depreſſion never can ſet the Variation of the two extreme Degrees ſo widely variable from the two Diameters, as the Ratio of Curvature can be demonſtrated to be changed by that very ſmall Depreſſion; and, as a Conſequence, the Quantity of the Degree given by the Quadrant, has no Relation to the Curvature, but has a particular Connection and Relation to Matter, and is not altered no more than the Diameters are altered by the aforeſaid ſmall Depreſſion. But, ſuppoſing that the Ratio of Curvature on a Spheroid, may vary from the Ratio of the Diameters in the before-mentioned Proportion, in one four by five, or nine by ten; and ſuppoſing the Degree of Gravity to take Place in Proportion to the Curvature, yet every Principle of Reaſon muſt needs expect that, when the Spheroid approaches near the Sphere, and converges cloſe upon it, as has been before-mentioned, the Ratio of Curvature ſhould alſo continually approach nearer to the Ratio of the Diameters, if ſo be the Degree of Gravity, which is what the Quadrant gives, did follow upon Curvature; but as this is never the Caſe, it is demonſtrable to a Perſon of Diſcernment, and who has made himſelf acquainted with the Subject, that Gravity is not connected with Curvature, neither in the Flat, Spheroid, nor converging ones, that nearly join the Sphere. It alſo may be illuſtrated and made demonſtrably manifeſt by the following Method:

Let a Variety of proportioned Spheroids be given, ſuppoſe in the following Order, One by Five, Two by Five, Three by Five, Four by Five, Nine by Ten; fix a certain Number which ſhall repreſent the Quantity of the Radia of the Great Circle, as ſhall circumſcribe the equatorial or tranſverſe Diameter of each Spheroid, which is ſuppoſed to be all equal; find alſo the Radia of Curvature in the two Extremes of each Spheroid, and note particularly what it is; alſo find the proportional Quantity of Matter that each ſeparate Spheroid does contain, and let each ſeparate Spheroid's ſolid Contents be reduced to perfect Spheres: alſo nicely obſerve what the Sum of two Radias will be of each Spheroid, when reduced to perfect Spheres. After this is done, ſubſtitute a Variety of Curve Tables as ſhall repreſent each particular Spheroidical Curve in all the Proportions before-mentioned: for Inſtance, for the Curve Table Four by Five; take for a beginning Number four Times 4095, which is the arithmetical Order of Number of the 90 Degrees, and four Times will be 16,380, the beginning Number of the Table, and by adding the Order of Number up, to 90 to it, will give a Diſtribution of Degrees, which ſhall repreſent the 90 Degrees of Gravity, and the firſt and laſt, when the Table is made, will be exactly in Proportion to the Spheroidical Curve as the Numbers repreſent, viz. Four by Five, and foraſmuch as in the Tables of the Lengths of Ellipſis, it can be proved that this Curve will be in Proportion to the Quadrant of the Great Circle as circumſcribed,

cumſcribed, as 71,686 is to 72,000, Caſt up all the Numbers in the Table into one Sum, and by dividing them by the Length of the Ellipſis, 71,686, and multiplying the Quotient by 72, gives the proportional Length in Numbers, as the Quadrant of the Great Circle, as circumſcribes, bears to the Curve repreſented by the Sum of the Tabular Numbers, and dividing the Product by 90, gives the Quantity of the Degree of the Quadrant, and by comparing this Degree found with the Tabular Numbers, I find it to be at the 81ſt Degree; and as all Radia is proportionable to the Degree, by ſubtracting this Degree from the Pole Degree in the Table, I find the Pole Degree exceeds it the one twenty-third Part, and by ſubtracting the Equatorial Degree, or the firſt Degree in the Table, from the Great Circle Degree, diſcovers, how much leſs than the Great Circle Degree; and by proceeding in this Manner with each reſpective Curve Table, which are made equal to the Diameters, all the various Proportions are accurately diſcovered. Thus the Great Circle Degree of a flat Spheroid; One by Five is found to be at the Seventy-firſt Degree, Two by Five at the Seventy-fifth Degree, Three by Five at the Seventy-eighth Degree, Four by Five at the Eighty-firſt Degree, Nine by Ten at the Eighty-firſt, and near Half, and ſo by any other proportioned Elliptic Curve, the Point where the Great Circle Degree falls is diſcovered exactly, granting thoſe Curves to be Ellipſis, or nearly ſo; but then what I call a Natural Curve or a Spheroidical Curve is conſiderably more diſtorted than the Ellipſis, and there is one particular Circumſtance belongs to it, which is this, that by making the firſt and laſt Degree equal to the two Diameters of the Spheroid, in the before-mentioned Order, where the Forty-fifth Degree does fall, the Convexity there found will be equal to that of the Great Circle, as circumſcribes; and in a Curve, One by Five, this Curve riſes above the Ellipſis nearly one fortieth Part of the Semi-Tranſverſe Diameter; but in the Curve of the Earth, which is Forty-five by Forty-ſix, it's diſtorted but nearly on the Two Hundredth Part of the Earth's Semi-Diameter, which amounts to about 20 miles in this Latitude. It is abſolutely neceſſary in finding the Quantity of the Degrees of Gravity on the Surface of the Spheriod, that a Method of Tabling ſhould be found to give a juſt Diſtribution to them, becauſe the ſmalleſt and largeſt Arch of Gravity on the Spheroid is always exactly equal to the two Diameters, and as Curvature or Convexity is ſuch an immenſe Diſtance from it, it is impoſſible to diſcover where the Degrees of Gravity are, or their true Quantities, without it; for though a Proceeding according to Circles, and Proportion from them, anſwers a Thouſand uſeful Purpoſes, yet in this it is found uſeleſs, becauſe Curvature is infinitely variable in infinite proportioned Spheroids, and Degrees of Gravity have not the leaſt Connection with it. The firſt and laſt Arch in the Curve of the Earth, as reſpects Gravity, is in the Proportion of 45 by 46; but the true Ratio of Curvature on its Surface is in the Proportion as 13 to 14; and by the fore-mentioned Method of Proceeding, the Center as will fit Curveture at the Equator is 150 Miles above the Earth's Center; whereas that which the Plummet tends to in paſſing towards the Pole is but 64 Miles above the Earth's Center; ſo again with reſpect to the Pole, the Center as will fit the Curvature found there is 240 Miles below the Earth's Center; whereas that which appertains to Gravity, and where the Plummet, in paſſing towards the Equator, tends to, is but 108 Miles below the Earth's Center, and exceeds the Great Circle Radia 21 Miles only; and all the various Proportions of Radia as it reſpects Curvature in the two Extremes of all Spheroids, or Radia as reſpects Gravity in the two Extremes, or Radia as reſpects Spheroids reduced to perfect Spheres, are by the before-mentioned Method fully and clearly diſtinguiſhed the one from the other, by which the Degree as reſpects Gravity can be demonſtrated to have no Connection with Curvature. Gravity reſpects Matter, and the Quantity of the Degree as reſpects Gravity will always bear a ſuitable Proportion to the Quantity of Matter contained in the Contents of the Spheroid; the Degree of Gravity on all Spheres will be increaſing but by a two-fold Proportion, whilſt the Quantity of Matter is increaſing by an eight-fold Proportion; two Degrees of Gravity in the extreme Parts of any Spheroid, added both together, never will exceed two Degrees of the perfect Sphere, or, which is the ſame Thing, two Degrees of the Great Circle which circumſcribes the Spheroid. Let what has now been ſaid reſpecting Radia be laid down in a Table at Sight, the Inconſiſtency of Curvature being Gravity will be obvious.

Spheroids Proportion.	Proportion of two Radias when collected into perfect Spheres.		Proportion of two Radias as reſpects the Gravity in the Spheroid.		Proportion of two Radias as reſpects the Curvature.	
	S D.	P.	S D.	P.	S D.	P.
$\frac{1}{5}$	1	$\frac{1}{6}$	1	$\frac{2}{3}$	2	$\frac{93}{100}$
$\frac{2}{5}$	1	$\frac{2}{5}$	1	$\frac{3}{4}$	2	$\frac{52}{100}$
$\frac{3}{5}$	1	$\frac{3}{5}$	1	$\frac{4}{5}$	2	$\frac{23}{100}$
$\frac{4}{5}$	1	$\frac{4}{5}$	1	$\frac{7}{8}$	2	$\frac{5}{001}$
$\frac{9}{10}$	1	$\frac{7}{8}$	1	$\frac{16}{17}$	2	$\frac{014}{1000}$

The two Radias of the two extreme Degrees being added together, the Table exhibits the Proportion as they bear to two Radias of the perfect Sphere, or, which is the ſame Thing, two Semi-Diameters of the Circle as circumſcribes, by which it is obvious that the Quantity of Degree and Radia reſpecting Curvature by increaſing in ſo extravagant a Manner as in Column the 4th, whilſt the Quantity

tity of Matter is diminiſhing, is a flat Contradiction to the Doctrine of Gravity, as its Object is the Quantity of Matter only; that the Quantity of Matter contained in an Oblate Spheroid, ſhould acquire more Degree and Radia, as in Column the 3d, by being changed and compreſt into that Shape, than it would be in a perfect Sphere, as in Column the 2d, is reaſonable and juſt; but that it ſhould acquire ſo large a Quantity of Degree and Radia as in Column the 4th, is altogether unreaſonable, unjuſt, and as great an Abſurdity as can be; that an Oblate Spheroid, One by Five, that does not contain but nearly a fifth Part of ſolid Matter of the perfect Sphere, that the two extreme Degrees, or Radias, added together, ſhould yet be not only as much as the whole Sphere, but near Half as much again, is full of the greateſt Abſurdity, as it reſpects Gravity. In all Spheroids, the Points where the Plummet is attracted to, both at the Conjugate and Tranſverſe, lie between the Point as will fit the Curvature and the Point of the Centre of Gravity, which is the Centre of the Spheroid, and always at the Conjugate Part nearer the Centre of Gravity than the Centre of Curveture; but in flat Spheroids the Tranſverſe, the Point that the Plummet is attracted to, is nearer the Center of Curvature than the Centre of the Spheroid, except Spheroids that approach nearer the Sphere than 4 by 5, or nearly ſo; then the Plummet at the Tranſverſe alſo tends to a Point nearer the Centre of the Spheroid than the Centre of Curvature, as has been already expreſſed in the Inſtance of the Earth. Becauſe the Quantity of the Degrees of Gravity on all Spheres will ever be proportionable to the Convexity found upon them, we are ready to conclude that this muſt needs be the Caſe with reſpect to the Spheroid, but it is by no means ſo: Suppoſe an oblate Spheroid in a vaſt Extreme, Pole's Axis One, Equatorial Diameter Five, for a Degree and Radia to be proportioned to the Curvature at the Pole, would be nearly as much as the Degree and Radia of a Sphere that would contain 400 times the Quantity of Matter as the whole Contents of the Spheroid given contains; and in the reverſe extreme Degree and Radia proportioned to Curvature at the Equator, would be little more than the $\frac{1}{400}$th part of the Quantity of Matter that the Spheroid given contains: this being the Caſe, it is as great a Contradiction to Sir Iſaac Newton's Doctrine, as Gravity reſpects Matter, as can be taken into Conſideration. Newton's Philoſophy, Page 60th, the Power of Gravity acts upon Bodies in Proportion to the Quantity of Matter in them. And again, Page 252, Attraction extends itſelf to every Particle of Matter; conſequently the Degree formed at the Tranſverſe ſhares a Part of the Conjugate Matter, and the Conjugate Degree is greatly leſſened by being connected with the Tranſverſe Part of the Spheroid; but by making the firſt and laſt Degree proportionable to the two Diameters, Conſiſtency and Harmony immediately take Place in any proportioned Spheroid whatever. There is no Neceſſity that the Degree formed by the Quadrant at the Equator, muſt needs be equal to the Degree on the Surface of a Sphere that ſhall fit the Curvature there, no more than that the Minutes given by the Quadrant in meaſuring acroſs mountainous Land on the Earth's Surface, muſt needs be leſs, becauſe the Convexity found there is much more ſo than the Great Circle: ſo neither at the Pole there is no Neceſſity that the Degree meaſured

ſured there muſt needs be equal to the Curvature, no more than there is a Neceſſity that a few Minutes meaſured by the Quadrant acroſs a Valley muſt needs be larger, becauſe it is a Concave Surface; the Minutes meaſured on the Concave or Convex Surface will be no ſenſible Difference, becauſe the Inequality of the Surface bears no ſenſible Proportion to the whole Maſs of Matter in the Globe, and the Object of Gravity is Matter only; and it is on this very Account that the Degrees in the two Extremes will be as before laid down.

Two Portions of Space on the Surface of any proportioned Spheroid in the two Extremes, perfectly conſiſtent with Gravity, may be obtained by this Method; beſect two right Lines at right Angles, from the Point of Interſection draw a great Circle as ſhall circumſcribe an Ellipſis drawn within it; ſuppoſe the Ellipſis Four by Five, at the conjugate Side of the Ellipſis, and at the Great Circle, ſet off one Degree; from thence draw a right Line to the Center where it cuts upon the conjugate Part of the Ellipſis, move that Space to the Tranſverſe End, and place the Great Circle Degree in its Room, and it is done, for the Ellipſis being Four by Five, the Space moved to the Tranſverſe End is four Parts out of five of the Great Circle Degree placed at the Conjugate, and ſo by any Proportion whatever; and as by Curve Table of Gravity, four by five, the Pole Degree will exceed the Degree of the Great Circle $\frac{1}{23}$d Part, ſo will that at the Equator. or at the Tranſverſe as reſpects Gravity, exceed the Space moved to there from the Conjugate $\frac{1}{23}$d Part of itſelf alſo, and is in exact Proportion to the two Diameters of the Spheroid given.

A Natural Curve, or Spheroidical Curve, fotmed by a Sphere's being in Motion, I define to be ſuch as is a Meridian found on the Earth's Surface, or Jupiter's Surface, or in a Planet's Orbit. Gravity being the ſame through the Whole of the Solar Syſtem, I take them to be all analogous and alike; and I take it to be as much a Law reſpecting Gravity for each reſpective Degree, Minute, or Second, on the Meridian and Earth's Surface, to form equal Areas to the Earth's Centre, as much as a Law in a Planet's Orbit to form equal Areas in equal Times to its Centre the Sun. A Method to form the Out-bounds of one of thoſe Curves by the Interſection of two Arches of Circles to come much nearer to it than the Ellipſis, may be done thus:—Suppoſe the Out-bounds of the Spheroid to be four by five, as before, draw a great Circle, beſect Lines at right Angles through it, from the Great Circle ſet in the Diſtance for the Pole intended, divide that Diſtance into four Parts, take five ſuch Parts and ſet them off from the Axis towards the Tranſverſe, with ten ſuch Parts ſet them down from the Tranſverſe Line on the Axis Line; through thoſe two Points (ſet off) draw a right Line to touch the Great Circle, from the Point on the Tranſverſe draw an arch to touch the right Line, and from the Point before ſet off on the Axis, draw an Arch from thence to the Pole, before ſet in, and it is done; and both thoſe Centres are between the Centre of the Spheroid and Centre as will fit the Curvature, and of Conſequence not ſo variable. It is very certain, then, that about 60 Degrees of Celeſtial Obſervation may be formed from the Tranſverſe Centre, and the Remainder of the 90 Degrees from that Centre on the Axis, and

and yet every Degree on the whole Surface of the Spheroid to be at right Angles from the Tangent at the Surface. I mention this Circumſtance becauſe perhaps ſome may think my Poſitions irreconcileable to the Nature of Things, as it is generally found to be that the Plummet tends to be at right Angles from the Tangent at the Surface; whilſt the Quadrant is paſſing from the Equator to the Pole, the Point where the Plummet tends to is continually paſſive with it, until it arrives at the Centre upon the Axis at the Pole; and with Reſpect to the Earth, the Plummet at the Equator tends to a Point 64 Miles above the Earth's Centre; but in paſſing on from thence 45 Degrees of the Meridian towards the Pole, the Point or Points that the Plummet is attracted to is continually in Motion on a Line nearly parallel to the Axis, until it arrives at about 50 Miles from the Point where it began from the Equator; and the Point that the Plummet tends to at the 45th Degree, is more than 70 Miles from the Earth's Centre, from thence the Points of Attraction (in meaſuring thoſe 45 Degrees to the Pole) paſs on near 100 Miles more, and nearly in a Line, and meet the Axis on an Angle of about 40 Degrees, and 108 Miles from the Earth's Centre; ſo that whilſt the Quadrant is paſſing from the Equator to the Pole, the Points or rather Line of Attraction is in Motion with it near 150 Miles, and which by the Operation of Gravity, revolves into itſelf, and keeps the Direction of the Plummet nearly at right Angles from all Tangents at the Surface; I ſay nearly, for it is not perfectly ſo but at the Equator and Pole; at the 45th Degree of Latitude the Point of Attraction being about 70 Miles from the Earth's Centre, as all Matter has a Share of Influence, and foraſmuch as the greateſt Quantity of Matter in the Spheroid as well as the Sphere in the Antipode, is in a direct Line through its Centre, the Attraction of the Plummet falls between two diſtant Powers, whilſt the Matter at the Surface, being ſo near, powerfully attracts the Plummet to be at right Angles to the Tangent, the Antipode claims a ſmall Share of Attraction alſo, and inclines the Plummet a ſmall Matter from being at perfect right Angles. Between the 40th and 50th Degrees of Latitude, I am inclined to think may be more than one Minute Inclination, ſo that the Face of the apparent Horrizon is not quite two equal Parts from the Zenith; whatever this Inclination is, all Waters as well as Lands are on the ſame Declivity, that is to ſay, it is higher towards the South than the North, and this Declivity is always kept in this State of Balance by the Power of centrical Force, which in this Latitude is more than 2000 Miles from the Axis, which is the ſame Effect as throws the Globe out at the Equator, and proceeds from the ſame Cauſe. It is reaſonable to ſuppoſe that the Globe, conſidered as one collective Maſs of Matter, that the Degree of Gravity on its Superfices ſhould fall in that State of Ratio, that they ſhould be all equal Areas to the common Centre of Gravity, it is altogether ſo in the Sphere, and that it ſhould not be ſo on the Spheroid alſo would be unjuſt, unreaſonable, and abſurd. Suppoſe this Globe to be the Denſity of Gold, or of Earth, or of Æther only, if the ſame Size and Figure as now, the Quantities of the Meridional Degrees at its Surface muſt needs be equal Areas to the common Centre of Gravity, whither we conſider reſpectively whole Degrees. Minutes or Seconds,

conds they are all like ſo many equal Wedges of Weight to the common Centre of Gravity, which is the Centre of the Spheroid.

What ſhould be the Reaſon then, that the Variation of the Diameters of this Globe ſhould be taken to be ſo very much leſs than they really are? The principal Reaſon is by taking the Curvature found on the Surface on the Meridian to be that Convexity as the Degrees of the Meridian, given by the Quadrant, originates their Quantities from, when in reality the Degree given by the Quadrant has to do nothing with the Matter contained in the whole Maſs, and not at all confined to Curvature.

Another great Reaſon, (and indeed what the firſt is included in), is by not entering into a deeper and juſt Diſcrimination of the Nature of the Thing itſelf, and the unreaſonable Abſurdity as muſt of neceſſity follow upon, by taking of Curvature on the Sphereoid for Gravity. Thus we find Sir Iſaac Newton himſelf making a Concluſion of the ſame kind; not immediately reflecting what its Effects would be on. His grand fundamental Doctrine, as Gravity reſpects Matter, which Doctrine ought to be conſidered as a fundamental Principle in the Newtonian Philoſophy, as it reſpects the Solar Syſtem; take this away, and you remove the very Hinge on which the Whole turns. But with reſpect to Curvature or Convexity, the Meridional Degree originating its Quantity from it, ought to be conſidered but as an Appendage of Science that in different Caſes might or might not be. On the Sphere muſt be, on the Spheriod cannot be. Thus we find in Sir Iſaac Newton's Works the two extreme Degrees of the Meridian given in the Ratio, as 76 to 77. Now taking this Ratio to be that of Curvature found on the two Extremes of the Sphereiod, the two Diameters anſwerable to this Curvature is nearly 230 by 231, which accounts for Sir Iſaac Newton's ſtating 34 miles ſhorteſt in the Pole's Axis, which proceeding from ſo great a Maſter, all have ſeemed implicitly to have followed the ſame Track, not even in the leaſt ſuſpecting the contrary; though Sir Iſaac Newton's fundamental Principles themſelves will eſtabliſh this juſt and commendable Deviation upon the moſt ſolid Newtonian Tenets. Whereas had the Ratio before given, viz. 76 by 77, been really taken for the Ratio of the Diameters, as what the Quadrant does really give in the two Extremes of the Meridian, the Ratio of Curvature anſwerable to ſuch Diameters is in the Proportion nearly as 25 by 26, ſo vaſt is the Miſtake by taking the Ratio of Curvature for Gravity; it being in ſuch an Extreme from it as has been before laid down. Granting theſe two Things, that the Pole Meridional Degree is attained by the Table of Meridional Degrees; and alſo that the Diameters are not leſs variable than the two extreme Meridional Degrees, the Evidence of which has been laid down, all other Circumſtances follow upon as Conſequences from thoſe two Known Ones; one, for Inſtance, is the true Shape of the Curve itſelf; for it is evident that if the Pole Meridional Degree and that at the Equator forms equal Areas to the Sphereoids common Centre of Gravity, the 45th Meridional Degree muſt needs do the ſame, and ſo of the reſt, of conſequence the Shape of the Curve is truly obtained, granting the 45 Meridional to be obtained by the Table, as it really is. Now tho' the Method here laid down, may not at firſt Sight ſeem ſo demonſtrable as that the Third Side

of

of a Right-angle Triangle is longer than either of the Legs, or that both Legs added together, muſt needs be longer than the Third Side; the firſt Inſtance given reſpecting Curvature not being Gravity by never joining the Ratio of the Diameters, it lies more abſtruſe and not ſo direct as the named Inſtance reſpecting the Triangle, yet it is not ſo indirect, but upon mature Reflection will be demonſtrably evident that Gravity is not connected with Curvature.

And again with reſpect to the Quantity of the Degree of Gravity given on the Superfices of Bodies, being in ſome ſuitable Conformity and Ratio of Proportion to the Quantity of Matter contained under thoſe Superfices, it may not at firſt Sight, without entering into the Nature of the Thing, ſeem to carry that full and direct Evidence that it muſt needs be as I here aſſert, yet this neither is ſo indirect but what ſufficient Evidence may be deduced from it, to render this thing fully demonſtrable; that is, allowing Sir Iſaac Newton's Principles Facts, as Gravity reſpects Matter. For certain it is in the before named Inſtance of an oblete Spheroid one by five, that making the firſt and laſt of the 90 Degrees one by five alſo, as all Radia Diameters and Circumference will be proportionable to the Degrees given. Two Spheres given variable in their Diameters as one to five, tho' the Variableneſs of the ſolid Contents of Matter will be in the Proportion, as 125 to 1. It can be made reconcileable to the Doctrine of Gravity, and that there may be ſo great a Variation of ſolid Matter as each reſpective Extreme Degree is attached to, tho' the Solid itſelf is but one by five that it is found on: but that the two Extreme Degrees as reſpects Gravity and on the ſame Solid, ſhould be as variable as near 50 to 1, as they really muſt be to be attached to Curvature, as all ſolid Matter is in Proportion to the Cubes of the Diameters, the ſolid Matter would fall as Variable nearly as 100000 to 1, though the Spheroid itſelf is but as 5 to 1. This being the Caſe, it is as demonſtrable that Gravity is not connected with Curvature, and alſo that it muſt be the ſame Ratio with the two Diameters given as the before named Inſtance reſpecting a Triangle when maturely reflected upon and underſtood. What has been laid down then will be ſufficient to convince all that are Judges of this Matter that this Globe is not only an Oblete Spheroid, but at leaſt as variable in its Diameter as the Proportion of 45 to 46, this being granted, then nothing remains but an Explanation of its real Uſe. Its Uſefulneſs then will appear by conſidering the Pains and Expence that have been taken to meaſure ſo many Meridional Degrees on the Earth's Surface, the French in Particular, it may be ſpoken to their eternal Honour as Mathematicians, their Performances at Lapland and Peru are of the greateſt Utility in this Matter, as well as many other Performances that have been done, all of which was to acquire the Bigneſs as well as the true Shape of the Earth; and yet it muſt be allowed on the ſtricteſt Scrutiny and by the moſt able Judges, that this important Buſineſs is but half done whilſt the Curvature is taken for Gravity. When it can be clearly demonſtrated to be actually otherwiſe, and that the ſmalleſt and largeſt Arch that can be meaſured at the Equator and at the Pole is alſo the true Diameters of the Earth; the firſt Thing then that recommends this Matter is the Truth of itſelf, which muſt needs be better than

Error. The Plummet alſo tending more than one whole Degree from the Centre of the Earth in this Latitude, is of much Importance to be known, as ſo many Things in Obſervation muſt needs be effected by it. At the Poles the Moon's Horizontal Parallex is leſſened by this Spheroidiſm the $\frac{1}{46}$th Part to what it is at the Equator; and in this Latitude its Horizontal Parallex is leſs than at the Equator by 50 Miles upon the Earth's Surface, a Circumſtance of Importance; another Thing is, that in croſſing the Tropics there is 50 Miles leſs Space from South to North, than the ſame Number of Degrees from Eaſt to Weſt on the Equator. Another Thing that recommends this Matter is, by its obtaining the Variation of all Degrees both of Latitude and Longitude; the true Diſtances of all Places on the Earth's Surface by Land can be attained with more Accuracy than they can poſſibly be known without it. All its Uſes indeed would be almoſt endleſs to enumerate, as muſt be obvious to thoſe that are Judges.

In the Subject then that I have laid down reſpecting the Spheroidiſm of this Globe, as I do verily believe it to be as I have here aſſerted, as much ſo as the Exiſtence of the Solar Syſtem, ſo I am very well perſuaded that if ſuch Perſons under whoſe Notice this may fall, will but take the ſame Aſſiduity to make themſelves well acquainted with the Method I have taken to inveſtigate every occurring Circumſtance that relates to this Matter, as I myſelf have done, will no longer doubt of its Truth and Authority, than they will of any demonſtrably known Thing whatever.

Reſult *from the Author's* Works.

		Miles.
Earth's Diameters.	At the Equator - -	8010.
	In the Pole's Axis - -	7836.
	Antipode to London - -	7952.

Reference

Reference to the Tables *herein laid down.*

The Firſt is the Table of the Ninety Meridional Degrees with every reſpective Increment of Increaſe, which has been already ſufficiently explained.

Next is Four Tables of the Diameters and Curvature in the two Extremes of near 100 different proportioned Spheroids, and from which Tables any Proportion required may be found. The Radia of the great Circle as circumſcribes the Spheroid is repreſented by 120 at the Bottom of Three of the Tables. And under Tranſvere is the Length of Radia as will fit the Curvature at the Tranſverſe, and what the Proportion is to that of 128, the Radia of the Great Circle; and under Conjugate is the Length of Radia as will fit the Curvature in the extreme Part of the Conjugate. Example, the Diameters of an Oblete Spheroid given 4 by 5, Table 1, what is the Proportion of Curvature or Radia in the two Extremes. The Radia as will fit the Curvature on the Extreme Part at the Tranſverſe is $\frac{81\ 558}{120\ 000}$ of the Radia of the Great Circle as circumſcribes the Spheroid, and at the extreme Part on the Conjugate, is found $\frac{165\ 426}{120\ 000}$ that is, it exceeds the Great Circles Radia $\frac{45\ 426}{120\ 000}$, and thoſe two Radias as will fit the Curvature compared together will be nearly in the Proportion as 1 to 2. So Table I. Diameters $\frac{29}{30}$ Radia or Curvature in the Extremes $\frac{8}{9}$. Table II. Diameters $\frac{100}{101}$, Radia or Curvature in the two Extremes $\frac{30}{31}$ nearly. Table III. Diameters $\frac{17279}{17280}$, Radia or Curvature in the two Extremes $\frac{4943}{4944}$. Table IV. Diameters $\frac{45}{46}$, Curvature $\frac{13}{14}$. Demonſtrable Evidence may be laid down from this Tabular Proceeding, what the Ratio of the Radias or Curvature is in the two Extremes in any Proportion whatever.

Next follows the Proportional Lengths of Ellipſis to the Quadrant, the Quadrant is repreſented by 32 at the Bottom of three of the Tables, and at the Top of Table I. is the Length of Radia to 72 the Quadrant, deduced from Van Culen's Proportion of the Diameter to the Circumference. Table I. Spheroid 3 by 5, and the Surface an Ellipſis is to the Quadrant of the Great Circle as circumſcribes the Spheroid, as 58,39 is to 72,00, and again Spheroid $\frac{24}{25}$, Ellipſis as 70, 45 to 72,00. Table II. Diameters $\frac{96}{97}$, Ellipſis nearly as 71,6 is to 72. And again in Table III. Diameters $\frac{1249}{1250}$, Ellipſis is to the Quadrant nearly as 71,968 is to 72,000. And ſo in Table IV. This Globe's Diameters being 45 by 46, was its Meridional Line an Ellipſis, the Total Sum of all the Meridional Degrees would be to the Quadrant of the Great Circle at the Equator, nearly as 71,155 is to 72,000; by this Method the Proportionable Length of any Ellipſis is diſcovered.

Next is placed two Tables as a Specimen of the Diſtribution of the Ninety Degrees as reſpects Gravity on the Surface of the two Sphereoids 4 by 5, and 9 by 10. Variety of Proportioned Curve Tables of this kind is made with the greateſt Eaſe, as it is only the Additionals of the Order of Numbers up to 90 added together.

In

In making Curve Tables, *take for the Beginning Number as underneath :*

Spheroids Proportion.

45	by	46	take	45	times	4095——	184275
19		20		19		4095——	77805
9		10		9		4095——	36855
4		5		4		4095——	16380
3		4		4		4095——	6142
2		5		4		4095——	2730
1		5		4		4095——	1024

And ſo by any proportioned Spheroid making the Firſt and Laſt Numbers in the ſame Proportion as the two Diameters, is an Arrangement or Diſtribution of the Proportional Quantities of the Ninety Degrees on its Superfices as reſpects Gravity. And here it ſhould be obſerved that as there is 91 Numbers in theſe Tables, the Firſt and Laſt is expreſſive of the Smalleſt and Largeſt Arch that can be found on the Spheroid. So in the Table of the Meriodinal Degrees or the Curve of the Earth, the Firſt Number aſſixed is no Part of the Curve itſelf, but the Expreſſion of the Quantity of the Degree of a Sphere that would infinitely near fit the Curvature that is found on the Equinoctial Line, and alſo ſuch Curvature as reſpects Gravity. The other 90 Numbers, their Quantity is the true Length of the Curve, ſeparate from the Firſt Point Number. Always account the Smalleſt and Largeſt Arch equal to the two Diameters as it really is, ſo as reſpects Gravity.

For Brevity ſake I have here ommitted inſerting my Table of the Longitudinal Degrees in every Degree of Latitude, and other Tables reſpecting the Variation of the Moon's Horizontal Parallax, as reſpects the Sphere or Spheroid.

TABLE

TABLE of the Quantity of every Meridional Degree in Feet and Parts, and alſo each reſpective Increment as every Degree increaſes by, from the Equator to the Pole.

Deg.	Ft.	P.	Feet.	Parts
0	0	000	362794	000
	1	944	362795	944
	3	888	362799	832
	5	832	362805	664
	7	776	362813	440
5	9	720	362823	160
	11	664	362835	824
	13	608	362848	432
	15	552	362863	984
	17	496	362881	480
10	19	440	362900	920
	21	384	362922	304
	23	328	362945	632
	25	272	362970	904
	27	216	362998	120
15	29	160	363027	280
	31	104	363058	384
	33	048	363091	432
	34	992	363126	424
	36	936	363163	360
20	38	880	363202	240
	40	824	363243	064
	42	768	363285	832
	44	712	363330	544
	46	656	363377	200
25	48	600	363425	800
	50	544	363476	344
	52	488	363528	832
	54	432	363583	264
	56	376	363639	640
30	58	320	363697	960
	60	264	363758	224
	62	208	363820	432
	64	152	363884	584
	66	096	363950	680
35	68	040	364018	720
	69	984	364088	704
	71	928	364160	632
	73	872	364234	504
	75	816	364310	320
40	77	760	364388	080
	79	704	364467	784
	81	648	364549	432
	83	592	364633	024
	85	536	364718	560
45	87	480	364806	040
45	87	480	364806	040
	89	424	364895	464
	91	368	364986	832
	93	312	365080	144
	95	256	365175	400
50	97	200	365272	600
	99	144	365371	744
	101	088	365472	832
	103	032	365575	864
	104	976	365680	840
55	106	920	365787	760
	108	864	365896	624
	110	808	366007	432
	112	752	366120	184
	114	696	366234	880
60	116	640	366351	520
	118	584	366470	104
	120	528	366590	632
	122	472	366713	104
	124	416	366837	520
65	126	360	366963	880
	128	304	367092	184
	130	192	367222	432
	132	192	367354	624
	134	136	367488	760
70	136	080	367624	840
	138	024	367762	864
	139	968	367902	832
	141	912	368044	744
	143	856	368188	600
75	145	800	368334	400
	147	744	368482	144
	149	688	368631	832
	151	632	368783	464
	153	576	368937	040
80	155	520	369092	560
	157	464	369250	024
	159	408	369409	432
	161	352	369570	784
	163	294	369734	080
85	165	240	369899	320
	167	184	370066	504
	169	128	370235	632
	171	072	370406	704
	173	016	370579	720
90	174	904	370754	680

TABLES of the Ratio of the Diameter and Curvature of the Spheroids in two Extremes.

TABLE I.

	Tranſverſe.	Proportion of Sphe-roids	Conjugate.	Proportion of Curva-ture.
0	8 136	$\frac{1}{5}$	343 608	$\frac{1}{42}$
	10 566		332 060	
	13 190		320 706	
	16 008		309 546	
	19 020		298 580	
	22 626		287 808	
6	25 626	$\frac{2}{5}$	277 230	$\frac{1}{11}$
	29 220		266 846	
	33 008		256 656	
	36 990		246 660	
	41 166		236 858	
	45 536		227 250	
12	50 100	$\frac{3}{5}$	217 836	$\frac{1}{4}$
	54 858		208 616	
	59 810		199 590	
	64 956		190 758	
	70 296		182 120	
	75 830		173 676	
18	81 558	$\frac{4}{5}$	165 426	$\frac{1}{2}$
	87 480		157 370	
	93 596		149 508	
	99 906	$\frac{9}{10}$	141 840	$\frac{2}{3}$
	106 410		134 366	
	113 108	$\frac{29}{30}$	127 086	$\frac{8}{9}$
24	120 000		120 000	

TABLE II.

	Tranſverſe.	Proportion of Sphe-roids.	Conjugiate.	Proportion of Curva-ture.
0	113 108	$\frac{29}{30}$	127 086	$\frac{8}{9}$
	113 391		125 786	
	113 674		126 487	
	113 958		126 159	
	114 243		125 891	
	114 527		125 593	
6	114 812		125 295	
	115 098		124 998	
	115 383	$\frac{45}{46}$	124 702	$\frac{13}{14}$
	115 669		124 405	
	115 956		124 109	
	116 242		123 813	
12	116 529		123 518	
	116 817		123 223	
	117 104		122 928	
	117 392		122 634	
	117 681	$\frac{100}{101}$	122 340	$\frac{30}{31}$
	117 969		122 046	
18	118 258		121 753	
	118 248		121 460	
	118 837		121 167	
	119 127		120 875	
	119 418		120 583	
	119 708		120 291	
24	120 000	$\frac{726}{737}$	120 000	$\frac{205}{206}$

TABLE III.

	Tranſverſe.	Proportion of Sphe-roids.	Conjugate.	Proportion of Curva-ture.
0	119 7089	$\frac{726}{727}$	120 2913	$\frac{205}{206}$
	119 7210		120 2792	
	119 7332		120 2671	
	119 7453		120 2549	
	119 7574		120 2428	
	119 7695		120 2306	
6	119 7816		120 2185	
	119 7938		120 2063	
	119 8059		120 1942	
	119 8180		120 1820	
	119 8301		120 1699	
	119 8423		120 1578	
12	119 8544	$\frac{1439}{1440}$	120 1456	$\frac{411}{412}$
	119 8665		120 1335	
	119 8786		120 1213	
	119 8908		120 1092	
	119 9029		120 0970	
	119 9150		120 0849	
18	119 9272		120 0728	
	119 9393		120 0606	
	119 9514		120 0485	
	119 9635		120 0364	
	119 9757		120 0242	
	119 9878		120 0121	
24	120 0000	$\frac{17279}{17280}$	120 0000	$\frac{4043}{4044}$

TABLE IV.

	Tranſverſe.	Proportion of Sphe-riods.	Conjugate.	Proportion of Curva-ture.
0	115 3838	$\frac{44}{45}$	124 7021	
	115 2957		124 6898	
	115 4076		124 6774	
	115 4195		124 6651	
	115 4314		124 6527	
	115 4433		124 6403	
6	115 4553		124 6380	
	115 4672		124 6156	
	115 4791	$\frac{45}{46}$	124 6033	$\frac{13}{14}$
	115 4910		124 5909	
	115 5029		124 5786	
	115 5148		124 5662	
12	115 5267		124 5539	
	115 5387		124 5415	
	115 5506		124 5292	
	115 5625		124 5168	
	115 5744		124 5045	
	115 5863		124 4921	
18	115 5985		124 4798	
	115 6102		124 4674	
	115 6221		124 4551	
	115 6340		124 4428	
	115 6459		124 4304	
	115 6579	$\frac{47}{48}$	124 4181	
24	115 6698		124 4057	

TABLES of the Proportional Length of Ellipſis's to the Quadrant.

Radia 45,8365. Quadrant 72,0000.

TABLE I.

Curves		
$\frac{0}{0}$	45	8365
	46	3806
	46	9667
	47	5946
	48	2644
$\frac{1}{5}$	48	9761
	49	7296
	50	5249
	51	3622
	52	2413
$\frac{2}{5}$	53	1622
	54	1250
	55	1297
	56	1763
	57	2647
$\frac{3}{5}$	58	3949
	59	5671
	60	7810
	62	0369
	63	3346
$\frac{4}{5}$	64	6742
	66	0556
$\frac{9}{10}$	67	4789
	68	9441
	70	4511
$\frac{5}{5}$	72	0000

TABLE II.

Curves		
$\frac{24}{25}$	70	4511
	70	5122
	70	5734
	70	6347
	70	6961
	70	7575
$\frac{32}{33}$	70	8190
	70	8805
	70	9422
	71	0038
	71	0656
	71	1274
$\frac{48}{49}$	71	1893
	71	2513
	71	3133
	71	3754
	71	4375
	71	4998
$\frac{96}{97}$	71	5620
	71	6244
	71	6868
	71	7493
	71	8119
	71	8745
$\frac{624}{625}$	71	9372
	72	0000

TABLE III.

Curves		
$\frac{624}{625}$	71	9372
	71	9397
	71	9422
	71	9447
	71	9472
	71	9497
	71	9523
	71	9548
	71	9573
	71	9598
	71	9623
	71	9648
$\frac{1249}{1250}$	71	9673
	71	9698
	71	9723
	71	9748
	71	9773
	71	9799
	71	9824
	71	9849
	71	9874
	71	9899
	71	9924
	71	9949
$\frac{15624}{15625}$	71	9974
	72	0000

TABLE IV.

Curves		
	71	1274
	71	1299
	71	1324
	71	1348
	71	1373
	71	1398
	71	1423
	71	1448
	71	1472
	71	1497
	71	1522
	71	1547
$\frac{45}{46}$	71	1572
	71	1597
	71	1622
	71	1647
	71	1672
	71	1697
	71	1722
	71	1746
	71	1771
	71	1796
	71	1821
	91	1847
	71	1872
	71	1893

CURVE TABLES.

4 by 5

0	16380		45	17415
	16381			17461
	16383			17508
	16386			17556
	16390			17605
5	16395		50	17655
	16401			17700
	16408			17758
	16416			17811
	16425			17865
10	16435		55	17920
	16446			17976
	16458			18033
	16471			18091
	16485			18150
15	16500		60	18210
	16516			18271
	16533			18333
	16551			18396
	16570			18460
20	16590		65	18525
	16611			18591
	16633			18658
	16656			18726
	16680			18795
25	16705		70	18865
	16731			18936
	16758			19008
	16786			19081
	16815			19155
30	16845		75	19230
	16876			19306
	16908			19383
	16941			19461
	16975			19540
35	17010		80	19620
	17046			19701
	17083			19783
	17121			19866
	17160			19950
40	1 200		85	20035
	17241			21121
	17283			20208
	17326			20296
	17370			20385
45	17415		90	20475

9 by 10

0	36855		45	37890
	30856			37936
	36858			37983
	36861			38031
	36865			38080
5	36870		50	38130
	36876			38181
	36883			38233
	36891			38286
	36900			38340
10	36910		55	38395
	36921			38451
	36933			38508
	36946			38566
	36960			38625
15	36975		60	38685
	36991			38746
	37008			38808
	37026			38871
	37045			38935
20	37065		65	39000
	37086			39066
	37138			39133
	37131			39201
	37155			39270
25	37180		70	39340
	37206			39411
	37233			39483
	37261			39556
	37290			39630
30	37320		75	39705
	37351			39781
	37383			39858
	37416			39936
	37450			40015
35	37485		80	40095
	37521			40176
	37558			40298
	37596			40341
	37635			40425
40	37675		85	40510
	37716			40596
	37758			40683
	37801			40771
	37845			40860
45	37890		90	40950